STOPPING WATER POLLUTION AT ITS SOURCE

MISA

Municipal/Industrial Strategy for Abatement

MONITORING COSTS AND THEIR IMPLICATIONS FOR DIRECT DISCHARGERS IN THE ONTARIO INORGANIC CHEMICAL INDUSTRY

FINAL REPORT

Ontario

Ministry of the Environment

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Minister

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MUNICIPAL-INDUSTRIAL STRATEGY FOR ABATEMENT
(MISA)

MONITORING COSTS AND THEIR IMPLICATIONS FOR DIRECT DISCHARGERS IN THE ONTARIO INORGANIC CHEMICAL INDUSTRY

FINAL REPORT

Socio-Economic Section
Policy and Planning Branch
Ontario Ministry of the Environment
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ABSTRACT

- Estimates of the incremental capital and operating costs to Ontario's twenty-two inorganic chemical plants who are direct dischargers subject to MISA monitoring requirements are derived and summarized. Cost estimates include information provided by plant representatives through the Canadian Chemical Producers' Association (CCPA).

- Five key monitoring activities are identified:

  - sampling requirements
  - analytical requirements (characterization and routine analyses)
  - toxicity testing
  - flow measurement
  - reporting

- Total incremental monitoring costs are estimated to be $5.6 million, as shown in Figure (a). These costs are comprised of $4.1 million in incremental operating costs and $1.5 million in incremental capital costs.

- Total estimated incremental costs by monitoring function are (shown in Figure (b)):

Sampling	$1.9 million
Characterization	$0.4 million
Routine Analyses	$2.5 million
Toxicity Testing	$0.2 million
Flow Measurement	$0.5 million
Reporting	$0.1 million

- Using a confidence measure of +/- 20%, monitoring costs could vary by about +/- $1.1 million.

- If the inorganic sector plants were subject to comprehensive, across-the-board monitoring requirements instead of plant and effluent-specific requirements, their routine analyses costs would be $19.4 million more than currently estimated. The results of this scenario are illustrated in Figure (c). This difference represents the cost-effectiveness of the proposed monitoring regulations.

- These cost estimates are not definitive, but indicate different levels of monitoring activity and associated cost ranges.

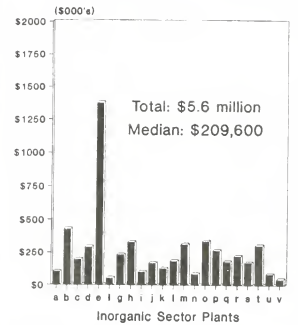
- An analysis of financial impacts of selected financial statistics indicates that the effects are varied but are not considered to be unduly burdensome.

- Financial data are publicly available for only eight firms in the sector so that effects on individual plants cannot be easily discerned due to the lack of plant-specific financial data.

- Figure (d) illustrates the impact of the incremental capital costs on average capital expenditures, and the impact of incremental operating costs on average net income levels for these eight firms.

Figure (a)

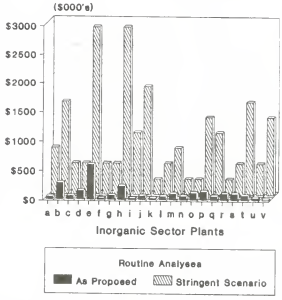
Inorganic Chemical Sector
Total Incremental Monitoring Costs



Source Table 2.8

Figure (c)

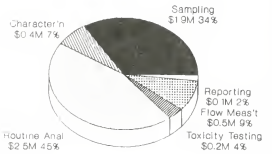
Inorganic Chemical Sector
Alternative Cost Scenario
For Routine Analyses



Source: Table 2.9

Figure (b)

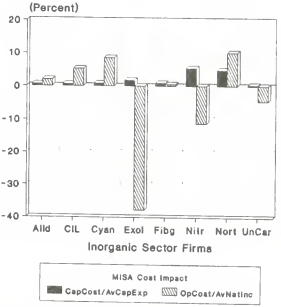
Inorganic Chemical Sector
Estimated Incremental Costs
By Monitoring Function



TOTAL: $5.6 million

Figure (d)

Inorganic Chemical Sector
Impact of Monitoring Costs on Selected
Financial Indicators of Firms



Source: Tables 3.1 and 3.2

1.0 BACKGROUND AND PURPOSE OF REPORT

1.1 MISA Objectives

MOE's Municipal-Industrial Strategy for Abatement (MISA) intends to achieve the "virtual elimination of toxic contaminants in municipal and industrial discharges into waterways."

The MISA program consists of four broad components:

1. Development and promulgation of Regulations which specify (a) contaminant monitoring requirements, and (b) effluent limits.

2. Development of these effluent limits based on "best available technology economically achievable" (BATEA) or water quality impacts.

3. Implementation of abatement programs and enforcement activities.

4. A comprehensive economic assessment program in conjunction with MISA program activities.

1.2 Sectors Affected by MISA

The MISA program will encompass at least 200 Ontario industrial and mining establishments which discharge contaminants directly into waterways disaggregated into nine industrial sectors:

- petroleum refining
- organic chemical manufacturing
- pulp and paper
- iron and steel
- metal mining and refining
- industrial minerals and manufacturing
- electric power generation
- inorganic chemical
- metal castings.

1.3 Effluent Monitoring Regulation for Inorganic Chemical Plants In Ontario

The first phase of the MISA regulatory program involves the promulgation of monitoring regulations for all plants within each of the industrial sectors listed above which discharge wastewater directly into the natural environment.

In this report, "sector" is defined as the 22 inorganic chemical plants subject to the MISA monitoring requirements, and "industry" as all the inorganic chemical producers in Canada and Ontario.

Nineteen firms with 22 plant locations (as of May 19, 1989) in the Inorganic Chemical sector are subject to the monitoring regulations:

1. Albright and Wilson Americas Inc. (Port Maitland)
2. Allied Chemicals Canada Inc. (Amherstburg)
3. Cabot Canada Ltd. (Sarnia)
4. C-I-L Inc. (Cornwall)
   C-I-L Inc. (Courtright)
   Stanchem, A Division of C-I-L Inc. (Cornwall)
5. Columbian Chemicals Canada Ltd. (Hamilton)
6. Cyanamid Canada Inc. - Niagara Plant (Niagara Falls)
   Cyanamid Canada Inc. - Welland Plant (Niagara Falls)
7. ETI Explosives Technologies International (Canada) Ltd. (North Bay)
8. Washington Mills Electro Minerals Corporation (Niagara Falls)
9. The Exolon-ESK Company of Canada Ltd. (Thorold)
10. Fiberglas Canada Inc. (Sarnia)
11. General Chemical Canada Ltd. (Amherstburg)
12. International Minerals and Chemicals Company (Canada) Ltd. (Port Maitland)
13. Nitrochem Inc. (Maitland)
14. Norton Canada Inc. (Niagara Falls)
15. Partek Insulations Ltd. (Sarnia)
16. Sulco Chemicals Limited (Elmira)
17. Union Carbide Canada Limited (Welland)
18. Washington Mills Limited (Niagara Falls)
19. Welland Chemical Ltd. (Sarnia)

The 22 plants subject to the MISA monitoring requirements account for 60% of the establishments located in Ontario.

As with any industry, the ownership and operation of these plants are evolving over time.

Following are some explanatory points:

. At the end of 1985, operations at the Amherstburg complex of Allied Chemicals were split between Allied and General Chemical Canada.

- The CIL plant in Cornwall shares the same manufacturing complex with Cornwall Chemicals Ltd., a plant subject to MISA's Organic Chemical Manufacturing Sector Monitoring Regulation.

- Washington Mills Electro Minerals Corporation and Washington Mills are both owned by the same U.S. parent - Washington Mills Abrasives Company. For this report, Washington Mills Electro Minerals will be cited as Electro Minerals.

- The IMC (International Minerals Corporation) site in Port Maitland has been shut down since 1984, and is now being used as a warehouse facility.

- While Stanchem is listed as a separate entity, it shares the same plant site as C-I-L (its parent company) in Cornwall. Since the sector monitoring regulations specify schedules for Stanchem, it will be treated as a separate plant for the purposes of this study.

The classifications of these plants in terms of Canadian SIC codes range from:

SIC	Description
3399	Carbon electrodes
3571	Abrasives industry, granular product
3594	Non-metallic mineral insulating industry
3711	Bulk inorganic chemical industry
3721-29	Chemical fertilizer industry
3799	Explosives industry

While the SIC classifications may not place all of these firms within one category, they have been taken together for the purposes of the MISA program because they process and/or produce inorganic chemicals.

Inorganic chemical sector monitoring requirements are specified in two regulations:

1. "Effluent Monitoring - General" which specifies common sampling, analysis, toxicity testing, flow measurement, recording and reporting protocols and procedures for all MISA sectors; and

2. "Effluent Monitoring - Inorganic Chemical Sector" which defines monitoring requirements specific to this sector.

The "Effluent Monitoring - General" regulation came into force June 7, 1988 and will continue in force for each MISA sector.

The Inorganic Chemical Sector Regulation will come into force five months after it is promulgated and continue in force during the subsequent 12-month period. It will be terminated, except for some daily monitoring of certain parameters, at the end of this period. Further monitoring requirements will then be specified in an "Effluent Limits Compliance Regulation" for the sector, expected to be promulgated in 1992.

A description of the inorganic chemical industry in Canada and Ontario is presented in the Economic and Financial Profile of the Ontario Inorganic Chemicals Industry (Woods Gordon, 1987), and is summarized in Section 3.2 of the present study.

1.4 Purpose and Objectives of Present Report

The monitoring requirements that result from the MISA program will likely be costly to achieve. Cost-effectiveness and benefit-cost implications were among the factors considered in arriving at the agreed-to protocols and requirements. Desired monitoring techniques and technologies have been determined through negotiations with the Canadian Chemical Producers' Association (CCPA), which represents the sector firms, through a Joint Technical Committee (JTC).

This report is intended to present estimates of incremental costs to the inorganic chemical sector plants in Ontario of the requirements of the sector monitoring regulation. The report will present an estimate of what the costs will be under the inorganic chemical sector regulations and what the costs could be if potential costs were incurred under a more comprehensive, across-the-board set of requirements. To the extent possible, therefore, the cost-effectiveness of the proposed inorganic chemical sector monitoring requirements have been examined in the present study.

This report also provides estimates of the economic implications of the monitoring costs on the sector, and where possible, on individual firms or plants.

As noted, this investigation is part of the economic assessment component of the MISA program. The economic rationale, purpose and elements of the economic component of the program are discussed in the report "Economic Information Needs and Assessments for Developing MISA Monitoring and Abatement Requirements" (Ontario, March 1987).

1.5 Cost Estimation Method

In general, two types of incremental costs of monitoring exist, one-time capital expenditures and potentially recurring operating expenses.

Capital equipment installed for monitoring or other purposes will have service lives of many years. Consequently, capital expenses will normally be depreciated over several years so that the full capital cost is not deducted against any single year. However, since the MISA monitoring regulations are to be in force for only 12-months, all operating and capital costs are assumed to be incurred in that single year. This results in a conservative assessment of sectoral cost implications.

In this report, capital and operating costs have been estimated for each monitoring function at each plant based on specifications in the regulations. Capital costs include costs incurred for equipment installations which may have continuing value.

Cost estimation includes the determination of activities and items which are required to implement each monitoring function, together with the use of simplifying assumptions where necessary. Estimates of costs of certain activities were supplied by industry sources, and through the auspices of the Canadian Chemical Producers' Association in response to direct requests from Ministry staff. The estimates provided by industry have been verified where possible.

Single-valued or point estimates of monitoring costs are presented, but should be regarded with some caution because:

- information received from individual plants varied in detail so that some cost estimates may have significant ranges;

- there is some flexibility as to how individual plants will actually implement some of the monitoring requirements;

- effluent quality differs from plant-to-plant and from pipe-to-pipe in the inorganic chemical sector. Therefore, the number of parameters to be monitored between plants and between pipes at individual plants varies with a corresponding variation in costs.

For the above reasons, ranges of costs are estimated for some monitoring functions where possible.

The cost of analytical testing was estimated by assuming that all analyses and toxicity testing will be performed by commercial laboratories. This assumption allows for comparable cost estimates for each of the plants within the sector.

All cost estimates are expressed in current dollars.

2.0 MONITORING COST ESTIMATES

2.1 Regulation Requirements

The General Effluent Monitoring Regulation specifies requirements for five major monitoring activities or functions which each wastewater discharger must implement to various degrees and levels of effort. These are:

1. Sampling requirements - Section 3
2. Analytical requirements (characterization and routine analyses) - Section 4
3. Toxicity testing - Section 5
4. Flow measurement - Section 6
5. Reporting - Section 7

Seven types of "sampling points" or effluent streams are defined in the specific Regulation for this sector:

1. Process effluent
2. Combined effluent
3. Batch discharge
4. Once-through cooling water
5. Waste disposal site effluent (leachate)
6. Stormwater
7. Emergency overflow

As shown in Table 2.1, the predominant stream types in this sector are combined effluent and stormwater.

Due to the diversity of processes within the sector, plant and stream-specific monitoring requirements were developed. This is in contrast to the petroleum refining sector, wherein each plant must test for the same compounds at the same frequency, but in accordance with the remaining sectors.

Table 2.1

Inorganic Chemical Sector
Number and Type of Effluent Streams Per Plant

Company	Plant Location	Effluent Stream *							TOTAL
		P	C	B	O	L	S	E	
Albright & Wilson Americas Inc.	Port Maitland		1				2		3
Allied Chemicals Canada Inc.	Amherstburg	3					3		6
Cabot Canada Ltd.	Sarnia		1					1	2
CIL Inc.	Cornwall	1	1						2
CIL Inc.	Courtright	1	7	1	2				11
Columbian Chemicals Canada Ltd.	Hamilton						2		2
Cyanamid Canada Inc.- Niagara Plant	Niagara Falls		2						2
Cyanamid Canada Inc.- Welland Plant	Niagara Falls		2		1		8		11
ETI (Canada) Ltd.	North Bay				1		3		4
Electro Minerals Corporation	Niagara Falls		2				5		7
The Exolon-ESK Company of Canada Ltd.	Thorold		1						1
Fiberglas Canada Inc.	Sarnia		1			1			2
General Chemical Canada Ltd.	Amherstburg		3						3
IMC Company (Canada) Ltd.	Port Maitland		1						1
Nitrochem Inc.	Maitland		1						1
Norton Canada Inc.	Niagara Falls		4				1		5
Partek Insulations Ltd.	Sarnia		1				3		4
Stanchem	Cornwall			1					1
Sulco Chemicals Limited	Elmira		1				1		2
Union Carbide Canada Limited	Welland		2		1	1	2		6
Washington Mills Limited	Niagara Falls		1				1		2
Welland Chemical Ltd.	Sarnia			2	3				5
TOTAL		5	32	4	8	2	31	1	83

* P=process C=combined B=batch discharge O=once-through cooling water
L=waste disposal site (leachate) S=stormwater E=emergency overflow

Source: Inorganic Sector Monitoring Regulation

2.2 Sampling Requirements

Sampling protocols and specifications are defined in Section 3 of the "Effluent Monitoring - General" regulation.

"Sampling" involves taking effluent samples from designated sampling points, collecting the samples, storing them under refrigeration where necessary, and then transporting them to laboratory facilities within a prescribed time period.

While commercial laboratory prices are assumed, some firms have indicated that they will likely perform some analyses in-house. This could lower estimated analytical costs, but could also result in added capital costs for expanded lab facilities. It is possible, of course, that in-house analyses increase both analytical costs and capital costs but firms are expected to choose the procedure that is least-cost.

It is assumed that each plant will dedicate a vehicle for the collection of samples within the plant. A new van costs about $18,000 to buy or $6,000 per year to lease. Assuming the vehicle travels 10,000 km/year at a government rate of $.275/km. (a likely over-estimate of actual operating costs), the annual operating cost would be $2,750/plant. If the truck is leased, the annual operating cost would be $8,750 with no capital.

In addition, it can be assumed that the vehicle will deliver samples to the commercial laboratory. Taking the round trip distance between each plant and a designated commercial laboratory (assumed to be located in Toronto), the additional annual operating cost per plant could range from $14,000 to $85,000 assuming the rate of $0.275/km. This may be an over-estimate, since most if not all plants will do daily sampling in-house (F. Ryan, MISA).

Assuming the truck is leased, total annual operating costs for the collection and transportation of samples can range from about $23,000 to $94,000 over the period of the regulation. For some plants, these are likely to be overestimates of the operating costs as indicated by the range of cost estimates provided by industry representatives, shown in Table 2.6.

If samples have to be stored prior to analysis, the regulations further require that they be maintained at a temperature no higher than $10^{o}C$, and they must be prevented from freezing. Therefore, each plant will require refrigeration equipment to store samples. Some plants may require more than one refrigerator due to the large number of samples taken and therefore may be able to take advantage of economies-of-scale.

A cost of $2,500 is assumed for each refrigerator to store samples.

Refrigeration equipment is also required to house automatic composite samplers. These units are usually included in the capital and installation costs of automatic sampler systems.

Table 2.2 indicates which plants have currently installed or will require automatic sampling devices and refrigerators for the storage of samples and samplers.

Automatic flow-proportional samplers, including refrigerators, cost between $7,000 and $10,000. Installation costs, which include temperature recorders, electrical supply, signal cables and construction, are sensitive to site-specific circumstances, and can total more than twice the equipment cost.

Estimates of capital costs for sampling were provided by 17 plants, whose estimates ranged from $0 to $329,000 (C-I-L, Courtright), as shown in Table 2.7. For those plants which did not submit their own estimates, a minimum capital cost of $12,500, consisting of $2,500 for a refrigerator and $10,000 for an automatic sampler, was assumed.

C-I-L's (Courtright) capital cost estimates include $254,000 for the construction of a new building which C-I-L claims is required because of the MISA program.

Two plants, Columbian Chemicals (Hamilton) and Stanchem (Cornwall) already had suitable sampling and refrigeration units and so will not have to incur any extra capital costs for sampling. Table 2.7 further shows that Sulco Chemicals estimate that they also will not incur incremental capital costs for sampling. This may imply that Sulco has not accurately considered possible MISA-related costs or that it already has suitable sampling and refrigeration units.

Table 2.2

Inorganic Chemical Sector
Monitoring Devices Required By Plant

Company	Plant Location	Sampling Devices	Refrig-erators	Flow Monit. Devices
Albright & Wilson Americas Inc.	Port Maitland	1	1	0
Allied Chemicals Canada Inc.	Amherstburg	1	1	1
Cabot Canada Ltd.	Sarnia	1	1	0
CIL Inc.	Cornwall	1	1	1
CIL Inc.	Courtright	1	1	1
Columbian Chemicals Canada Ltd.	Hamilton	0	0	0
Cyanamid Canada Inc.- Niagara Plant	Niagara Falls	1	1	0
Cyanamid Canada Inc.- Welland Plant	Niagara Falls	1	1	0
ETI (Canada) Ltd.	North Bay	1	1	1
Electro-Minerals Corporation	Niagara Falls	1	1	0
The Exolon-ESK Company of Canada Ltd.	Thorold	1	1	0
Fiberglas Canada Inc.	Sarnia	1	1	0
General Chemical Canada Ltd.	Amherstburg	1	1	0
IMC Company (Canada) Ltd.	Port Maitland	1	1	0
Nitrochem Inc.	Maitland	1	1	0
Norton Canada Inc.	Niagara Falls	1	1	0
Partek Insulations Ltd.	Sarnia	1	1	0
Stanchem	Cornwall	0	0	0
Sulco Chemicals Limited	Elmira	1	1	0
Union Carbide Canada Limited	Welland	1	1	0
Washington Mills Limited	Niagara Falls	1	1	0
Welland Chemical Ltd.	Sarnia	1	1	1
TOTAL		20	20	5

Legend: "1" = plant will require a suitable device(s)
"0" = plant has a suitable device(s)

Source: MOE, Water Resources Branch, 1989

Based on the foregoing discussion, total capital and operating costs of sampling for the inorganic chemical sector should be in the order of about $700 thousand. This compares to the total costs for sampling activities, as provided by industry representatives and any working assumptions, which are estimated to range from about $4,000 (Welland Chemical, Sarnia) up to $412,000 (C-I-L, Courtright) per year per plant, totaling about $1.9 million for the whole sector. These point estimates are shown in Tables 2.6 and 2.7.

The broad range of these estimates among the plants reflects the differing sampling requirements among sector firms. It is also possible that the definition of "sampling costs" varies from plant to plant, and may or may not incorporate all the components discussed above. It is also possible that some firms have not yet properly assessed any additional expenditures required to meet MISA regulations.

2.3 Characterization Analyses

Characterization analyses involve the quantitative determination of individual organic and inorganic parameters from the sector list which is a subset of EMPPL. The purpose of characterization analyses is to detect non-routine, frequently occurring contaminants with greater than 99% probability of success.

Each inorganic chemical sector plant will have to characterize its process, combined effluents and batch discharge streams for 147 chemicals listed on the Inorganic Chemical Sector list. To the extent that specific parameters are already routinely tested, additional characterization analyses will not be required. For those parameters which do require characterization analyses, the Sector Regulation (Section 5) specifies two testing frequencies on a site-specific basis.

To accommodate differences among sector plants and to utilize cost-effectiveness in the requirements, the sector was divided into two sub-categories, A and B, for characterization purposes. The frequencies in each sub-category are based on the following considerations (Inorganic Chemical Sector Regulation, Section XII):

- number of product types manufactured at a site

- process complexity
- process variability
- product/raw material type
- availability of relevant historical characterization data
- past and current environmental performance

Sub-category A involve simple process sites, and plants in this category are required to perform two characterizations per year. Sub-category B plants, referring to complex process sites, must perform four characterizations per year. Two exceptions are Partek Insulations (Sarnia) which must perform six characterizations per year on its combined stream, and Columbian Chemicals (Hamilton) which is not required to conduct characterizations since its effluent discharge is classified as stormwater (F. Ryan, MISA; MOE, 1989a). Plants per category are shown in Table 5 of the Technical Rationale for the sector-specific monitoring regulation (MOE, 1989a).

As noted earlier, it is assumed that characterization, toxicity testing, and routine analyses will be performed by commercial laboratories, even though some plants have the ability to conduct many of the analyses on-site. This has been done in order to obtain cost estimates for each of the plants which can be compared on common bases.

Commercial laboratory test prices are listed in Table 2.3 and are based on a survey of Canadian and U.S. border state commercial laboratories (Dillon, 1988) prepared for MOE. The 27 test groups listed contain about 150 individual chemicals. In addition, open scans (organic/elemental) must be carried out on each set of samples. The laboratories surveyed include commercial, private, municipal and institutional facilities.

These prices may be high in that they do not account for volume discounts. For example, it is calculated that, for the inorganic chemical sector, close to 77,000 tests per year will be required for routine analyses alone. On the other hand, they do not reflect substantial price increases some labs have instituted during the last six months. These two opposing biases probably tend to cancel each other out.

Prices of laboratory tests include quality assurance/quality control (QA/QC) samples and the preparation of required reports, but do not include transport, which was discussed in Section 2.1.

Table 2.3

Average Ontario Commercial Laboratory Prices
For Analytical Test Groups

	Analytical Test Group	Average Price
1	Chemical Oxygen Demand (COD)	$29.78
2	Cyanide	$36.10
3	Hydrogen Ion (pH)	$6.84
4	Nitrogen	$86.99
5	Organic Carbon (DOC)	$57.03
6	Total Phosphorus	$25.12
7	Specific Conductance	$9.44
8	Suspended Solids (TSS/VSS)	$14.87
9	Total Metals	$84.10
10	Hydrides	$23.33
11	Chromium (Hexavalent)	$20.47
12	Mercury	$25.77
13	Total Alkyl Lead	$172.00
14	Phenolics (4AAP)	$42.93
15	Sulphide	$29.80
16	Volatiles, Halogenated	$239.90
17	Volatiles, Non-Halogenated	$176.81
18	Volatiles, Water Soluble	$126.50
19	Extractables, Base Neutral	$427.49
20	Extractables, Acid (Phenolics)	$245.68
21	Extractables, Phenoxy Acid Herbicides *	$188.09
22	Extractables, Organochlorine Pesticides *	$270.14
23	Extractables, Neutral-chlorinated	$232.04
24	Chlorinated Dibenzo-p-dioxins and Dibenzofurans	$1,228.27
25	Solvent Extractables (oil & grease)	$36.00
26	Fatty and Resin Acids	$133.18
27	PCBs (Total)	$103.90
IC1	Chloride	$23.58
IC2	Fluoride	$24.92
IC3	Sulphate	$24.33
--	Gas Chromatography and Mass Spectrometry Open Scans	$850.00

* Does not apply to the Inorganic Chemical Sector

Source: M.M.Dillon, "Inventory and Critical Review of Laboratory Resources", July 1988; MOE, Water Resources Branch, 1989

Table 2.4 summarizes the operating costs for characterization analyses, excluding transportation, per plant. Total annual characterization costs amount to about $358,000 for the inorganic chemical sector. These costs are over and above the routine analytical costs.

These cost estimates do not include pre-regulation characterization analyses, which have already been carried out. Costs of these tests were estimated by industry representatives to total $300,000 for the inorganic chemical sector. Pre-regulation monitoring is not explicitly required by the Regulations so these costs are not attributable to the regulations.

2.4 Routine Analyses

Routine analyses involve testing of samples taken at four frequency levels - daily, three times per week, weekly and monthly, plus on an event basis for certain sampling points such as emergency overflow.

Two additional grab samples are required from waste disposal sites and stormwater effluents between January and May in order to estimate the effects of snow-melt conditions. The incremental cost of these two additional samples are estimated total $30,000 for all of the plants in this sector.

Each plant has its own specific monitoring requirements under the regulations because of the variety of processes and contaminants found from plant to plant. The number and costs of routine monitoring therefore vary from plant to plant.

As seen in Table 2.4, the annual operating cost of routine analyses range between $5,400 (Welland Chemical, Sarnia) and $589,000 (C-I-L, Courtright) per plant per year. The total point estimate for all 22 plants amounts to $2.4 million per year. These estimates exclude transportation.

C-I-L (Courtright) further estimated that it will have to expend $120,000 for continuous analyzers for amonia, pH and conductivity. This capital cost is shown in Table 2.7.

Table 2.4

Inorganic Chemical Sector
Analytical Requirements - Operating Costs
($000's)

Company	Plant Location	Routine Analyses					% of Total (Rout)	Character-ization Analyses*	TOTAL ANALYT REQ'S
		Daily	3/Week	Weekly	Monthly	TOTAL			
Albright & Wilson Americas Inc.	Port Maitland	20.5	0.0	10.6	11.6	42.7	2%	7.5	50.2
Allied Chemicals Canada Inc.	Amherstburg	22.7	183.8	13.2	55.6	275.3	12%	31.4	306.7
Cabot Canada Ltd.	Sarnia	11.4	16.8	14.8	15.4	58.4	2%	6.7	65.1
CIL Inc.	Cornwall	41.6	47.3	31.8	22.2	142.9	6%	22.0	164.9
CIL Inc.	Courtright	467.1	19.2	72.3	30.8	589.4	25%	101.0	690.4
Columbian Chemicals Canada Ltd.	Hamilton	0.0	0.0	0.0	17.5	17.5	1%	0.0	17.5
Cyanamid Canada Inc.- Niagara Plant	Niagara Falls	22.7	11.3	18.2	15.7	67.9	3%	13.1	81.0
Cyanamid Canada Inc.- Welland Plant	Niagara Falls	104.6	40.7	15.7	64.6	225.6	10%	16.9	242.5
ETI (Canada) Ltd.	North Bay	0.0	0.0	0.0	15.4	15.4	1%	0.0	15.4
Electro Minerals Corporation	Niagara Falls	22.7	0.0	23.2	16.3	62.2	3%	15.5	77.7
The Hexolon-ESK Company of Canada Inc.	Thorold	11.4	0.0	10.5	0.2	22.1	1%	7.8	29.9
Fiberglas Canada Inc.	Sarnia	27.0	8.9	10.8	6.6	53.3	2%	7.4	60.7
General Chemical Canada Ltd.	Amherstburg	22.7	36.3	31.9	7.0	97.9	4%	14.2	112.1
IMC Company (Canada) Ltd.	Port Maitland	29.6	3.8	10.8	15.1	59.3	3%	5.3	64.6
Nitrochem Inc.	Maitland	43.1	0.0	46.0	25.0	114.1	5%	4.7	118.8
Norton Canada Inc.	Niagara Falls	45.5	43.2	43.1	5.7	137.5	6%	30.7	168.2
Partek Insulations Ltd.	Sarnia	11.4	19.8	12.0	15.8	59.0	3%	22.4	81.4
Stanchem	Cornwall	11.4	78.8	9.6	2.8	102.6	4%	6.5	109.1
Sulco Chemicals Limited	Elmira	11.4	66.4	12.8	8.9	99.5	4%	7.0	106.5
Union Carbide Canada Limited	Welland	22.7	14.9	16.8	18.4	72.8	3%	16.9	89.7
Washington Mills Limited	Niagara Falls	11.4	7.5	10.5	3.3	32.7	1%	7.8	40.5
Welland Chemical Ltd.	Sarnia	0.0	0.0	0.0	5.4	5.4	0%	12.9	18.3
TOTAL		960.9	598.7	414.6	379.3	2,353.5	100%	357.7	2,711.2

* Characterization plus Open Characterization costs.

Source: Inorganic Chemical Sector Monitoring Regulation

2.5 Toxicity Testing

Biological toxicity testing consists of acute lethality tests of the static 96-hour rainbow trout toxicity test and a 48-hour Daphnia magna (a small water flea) mortality test.

Process and combined effluents, and batch streams which are final discharge points, are to be tested monthly while once-through cooling water will be tested quarterly.

If three consecutive monthly trout tests result in mortality for no more than two out of ten fish, trout tests for the remaining 9 months can be carried out on a pass/fail basis. Similarly, if the first quarterly results for once-through cooling water have no more than 20% mortality for the fish, the remaining three tests on trout and Daphnia magna may be carried out on a pass/fail basis. This provision does not apply to the Daphnia magna test on process, combined and batch effluents, which must be tested monthly.

Table 2.5 displays the maximum and minimum costs for toxicity tests that could be required annually at each plant for final discharge points including once-through cooling water.

Toxicity testing costs are based on the following prices for full dilution series:

Trout:	$360 per test
Daphnia:	$240 per test
	$600 per test

Toxicity testing costs for trout on a pass/fail basis are $225 per test (D. Kerr, Industry Liaison).

These prices do not include costs of collecting samples and transport to a laboratory (see Section 2.2). Based on the experience of some plants in the Organic Chemical Manufacturing Sector, these additional costs can be as much as $100 per test (OCM Industry Representatives, 1988).

The total cost of this function, assuming the maximum number of mortalities during the 12-month period, amounts to $208,800 as shown in Table 2.5. If a minimum number of mortalities occurred, the total annual cost for toxicity testing would be $173,565, a difference of $35,235.

Table 2.5

Inorganic Chemical Sector
Toxicity Testing Costs
(5)

Company	Plant Location	Number of Tests/Year		Costs*				
				Trout		Daphnia	TOTAL	
		Trout	Daph	Max	Min		Max	Min
Albright & Wilson Americas Inc.	Port Maitland	12	12	4,320	3,105	2,880	7,200	5,985
Allied Chemicals Canada Inc.	Amherstburg	0	0	0	0	0	0	0
Cabot Canada Ltd.	Sarnia	12	12	4,320	3,105	2,880	7,200	5,985
CIL Inc.	Cornwall	12	12	4,320	3,105	2,880	7,200	5,985
CIL Inc.	Courtright	12	12	4,320	3,105	2,880	7,200	5,985
Columbian Chemicals Canada Ltd.	Hamilton	0	0	0	0	0	0	0
Cyanamid Canada Inc.- Niagara Plant	Niagara Falls	24	24	8,640	6,210	5,760	14,400	11,970
Cyanamid Canada Inc.- Welland Plant	Niagara Falls	16	16	5,760	4,140	3,840	9,600	7,980
ETI (Canada) Ltd.	North Bay	4	4	1,440	1,035	960	2,400	1,995
Electro-Minerals Corporation	Niagara Falls	24	24	8,640	6,210	5,760	14,400	11,970
The Exolon-ESK Company of Canada Ltd.	Thorold	12	12	4,320	3,105	2,880	7,200	5,985
Fiberglas Canada Inc.	Sarnia	12	12	4,320	3,105	2,880	7,200	5,985
General Chemical Canada Ltd.	Amherstburg	24	24	8,640	6,210	5,760	14,400	11,970
IMC Company (Canada) Ltd.	Port Maitland	12	12	4,320	3,105	2,880	7,200	5,985
Nitrochem Inc.	Maitland	12	12	4,320	3,105	2,880	7,200	5,985
Norton Canada Inc.	Niagara Falls	48	48	17,280	12,420	11,520	28,800	23,940
Partek Insulations Ltd.	Sarnia	12	12	4,320	3,105	2,880	7,200	5,985
Stanchem	Cornwall	12	12	4,320	3,105	2,880	7,200	5,985
Sulco Chemicals Limited	Elmira	12	12	4,320	3,105	2,880	7,200	5,985
Union Carbide Canada Limited	Welland	28	28	10,080	7,245	6,720	16,800	13,965
Washington Mills Limited	Niagara Falls	12	12	4,320	3,105	2,880	7,200	5,985
Welland Chemical Ltd.	Sarnia	36	36	12,960	9,315	8,640	21,600	17,955
TOTAL		348	348	125,280	90,045	83,520	208,800	173,565

* Trout: $360/test (acute lethality), $225/test (pass/fail)
Daphnia: $240/test

[Difference (max-min): $35,235]

Source: Inorganic Chemical Sector Monitoring Regulations, Section 15

2.6 Flow Measurement

Flow measurement is necessary to determine total loadings of contaminants discharged to the environment. Chemical analyses reveal concentrations (mass/volume). Flow is measured in volume/unit time. The product of concentration and flow is mass/unit time (e.g. kg/d), the measure of loadings.

Primary and secondary flow measurement devices are required to achieve the accuracy specified for the process and combined sampling points. Table 2.2 indicates that at least five plants will require primary and secondary flow measurement devices. The number required at each plant can vary from one to eleven.

Installation costs will vary among plants due to site-specific characteristics as the volume of effluent flow, location of pipes, etc.

Flow measurement accuracy requirements are a function of stream type. Continuous flow measurement at an accuracy of +/-5% for the primary element and +/-2% of full scale for the secondary element is required for process effluents, and an accuracy of +/-20% is required for all other stream types.

Estimated operating costs of flow measurement provided by industry representatives and range from $0 to $5,000 as shown in Table 2.6. For those plants who did not provide estimates, it was assumed that a nominal $1,000 per year would be expended to generate flow measurement.

Industry representatives were also asked to provide estimates of capital expenditures for flow measurement. These estimates range from $0 to $120,000 (C-I-L, Courtright) per plant, as shown in Table 2.7. The high capital cost for C-I-L at Courtright reflects the rerouting of six sampling points and the need for additional flow measurement devices for each of these streams.

For those plants which did not provide estimates, the capital costs for flow measurement were estimated to be $10,000 per year for plants with five effluent streams or less, and $20,000 per year for plants with greater than five effluent streams. These estimates were interpolated from estimates that were provided.

The above estimates are not out of line with estimates provided by other sources. For example, in a report prepared for MOE, Gore and Storrie (1987) correlate flow rates and estimated pipe sizes to the costs of different new flow measurement devices. For example, an in-line magnetic flow meter may cost an average of $6,700 for a 6" pipe, and up to $40,600 for a 48" pipe. These costs could be underestimates, since there may be additional installation costs.

These ranges may reflect the fact that some plants already have adequate flow measurement installations.

2.7 Reporting

Monitoring data will have to be assembled, recorded, stored, and reported to company management and to the Ministry of the Environment.

Data storage and manipulation will require an AT personal computer together with compatible peripherals and software, plus personnel dedicated to perform report generation functions.

Total capital and operating cost estimates for reporting were supplied by the individual plants and vary greatly, ranging from $0 up to $20,000 (C-I-L, Courtright), and totaling about $81,000 for the inorganic chemical sector. These differences appear to be due to the availability of existing facilities. For those plants from whom no estimates were received, a nominal annual operating cost of $1,000 based on available estimates is assumed. No nominal capital costs were assumed, since it is likely that most plants already have computers. Cost estimates for reporting are displayed in Tables 2.6 and 2.7.

2.8 Pre-Regulation Consultation and Meetings

Industry representatives from the inorganic chemical sector spent time at meetings and review committees in order to participate in the development of the regulations.

Based on information received from the companies involved, industry representatives spent an estimated 196 person-days in meetings with the Sector Joint Technical Committee (JTC) and its Analytical and Regulation Subcommittees since

September 1987. Assuming an average rate of $400/day, the cost of pre-regulation meetings to the 22 sector plants has been about $78,400 (D. Kerr - based on estimate provided by C-I-L (Courtright)).

In addition, the inorganic chemical sector companies report that about 165 person-days were expended over 12-months to undertake pre-regulation monitoring tasks. Assuming an average hourly rate of $25, the cost of pre-regulation monitoring was about $30,900 for the sector plants (D. Kerr - based on estimate provided by C-I-L (Courtright)).

In total, 356 person-days, with a total cost of over $109,000, were required for pre-regulation assessments, consultation and meetings. This figure is likely an underestimate, since it has been assumed, in the absence of any plant-provided estimate, that each plant spent a minimum of 10 person-days on these activities.

2.9 Intake Water

Another potential sampling point is intake water. The Inorganic Chemical Sector Regulations do not require monitoring requirements for intake water. However, some plants obtain water from large surfacewater sources, which in turn receive wastewater discharges of other municipalities and industrial plants. Data on intake water quality would permit the firms to calculate net loadings of contaminants generated by the plant. Since most inorganic chemical sector plants will likely monitor intake water, cost estimates are presented in this report for comparative purposes.

Eight of the 22 plants provided specific estimates of intake water monitoring costs ranging from $4,900 to $30,000. The total estimated cost of intake monitoring for these eight plants is $124,000.

2.10 Total Estimated Costs of the MISA Inorganic Chemical Sector Monitoring Requirements

Table 2.6 presents a summary of the operating cost estimates for each monitoring function. The total operating costs of compliance are estimated to be about $4.1 million, and will be incurred over the 12-month tenure of the monitoring Regulation.

Table 2.6

Inorganic Chemical Sector
Summary of Incremental Operating Costs by Monitoring Function
($000's)

Company/Plant	Plant Location	Sampling	Characterization	Routine	Toxicity Testing	Flow Measurement	Reporting	TOTAL OPERATING COSTS	% Of Total
Albright & Wilson Americas Inc.	Port Maitland	31.3	7.5	42.7	7.2	1.0	1.0	90.7	2%
Allied Chemicals Canada Inc.	Amherstburg	50.4	31.4	275.3	0.0	0.0	0.0	357.1	9%
Cabot Canada Ltd.	Sarnia	50.0	6.7	58.4	7.2	1.0	1.0	124.3	3%
CIL Inc.- Cornwall *	Cornwall	94.1	22.0	142.9	7.2	1.0	1.0	268.2	7%
CIL Inc.- Courtright	Courtright	83.2	101.0	589.4	7.2	5.0	10.0	795.8	19%
Columbian Chemicals Canada Ltd. *	Hamilton	22.8	0.0	17.5	0.0	1.0	1.0	42.3	1%
Cyanamid Canada Inc.- Niagara Plant	Niagara Falls	36.9	13.1	67.9	14.4	0.0	6.2	138.5	3%
Cyanamid Canada Inc.- Welland Plant	Niagara Falls	10.2	16.9	225.6	9.6	1.0	2.3	265.6	6%
ETI (Canada) Ltd.	North Bay	35.4	0.0	15.4	2.4	0.0	4.6	57.8	1%
Electro Minerals Corporation	Niagara Falls	56.0	15.5	62.2	14.4	0.0	5.0	153.1	4%
The Exolon-ESK Company of Canada Ltd.	Thorold	65.0	7.8	22.1	7.2	0.0	0.0	102.1	2%
Fiberglas Canada Inc.	Sarnia	5.0	7.4	53.3	7.2	5.0	1.0	78.9	2%
General Chemical Canada Ltd.	Amherstburg	157.0	14.2	97.9	14.4	0.0	5.0	288.5	7%
IMC Company (Canada) Ltd.	Port Maitland	8.9	5.3	59.3	7.2	0.0	1.0	81.7	2%
Nitrochem Inc.	Maitland	100.0	4.7	114.1	7.2	0.0	0.0	226.0	6%
Norton Canada Inc. *	Niagara Falls	34.8	30.7	137.5	28.8	1.0	1.0	233.8	6%
Partek Insulations Ltd. *	Sarnia	67.0	22.4	59.0	7.2	1.0	1.0	157.6	4%
Stanchem *	Cornwall	94.0	6.5	102.6	7.2	1.0	1.0	212.3	5%
Sulco Chemicals Limited	Elmira	60.0	7.0	99.5	7.2	0.0	0.0	173.7	4%
Union Carbide Canada Limited	Welland	24.0	16.9	72.8	16.8	5.0	6.0	141.5	3%
Washington Mills Limited	Niagara Falls	25.0	7.8	32.7	7.2	0.0	2.5	75.2	2%
Welland Chemical Ltd.	Sarnia	1.5	12.9	5.4	21.6	0.0	0.0	41.4	1%
TOTAL		1,112.5	357.7	2,353.5	208.8	23.0	50.6	4,106.1	100%

Notes:

* Estimates not provided by these plants.

For those plants who did not provide cost estimates, assumptions were made:

-Sampling costs include leasing 1 vehicle @$8,750 plus transporation to a lab in Toronto.

-Flow measurement and reporting costs of $1,000 each.

Characterization/Routine/Toxicity costs calculated by MOE staff.

Source: Inorganic Sector Representatives; Inorganic Sector Monitoring Regulation

Table 2.7 shows that the total capital costs of compliance are estimated to be about $1.5 million.

Point-estimates of the total incremental capital and operating costs (rounded to millions of dollars) for each monitoring function are as follows:

Sampling	$1.9 million (34%)
Characterization	$0.4 million (7%)
Routine Analyses	$2.5 million (45%)
Toxicity Testing	$0.2 million (4%)
Flow Measurement	$0.5 million (9%)
Reporting	$0.1 million (2%)

The total point-estimate of the monitoring cost for this sector of the MISA related requirements is about $5.6 million. This does not include intake water analysis costs.

C-I-L at Courtright stands out with a total estimated incremental cost of $1.4 million. This is attributed to the fact that this plant has a large number of streams resulting from complex production processes. Thus, the monitoring requirements tend to be more onerous. Furthermore, this C-I-L plant claims a large capital expense of $254,000 for a new building required as a consequence of the MISA program.

These cost estimates are subject to varying degrees of uncertainty. Using an uncertainty measure of +/- 20%, the total costs of the regulation requirements could range from $4.5 million to $6.7 million.

Total operating and capital costs for the inorganic chemical sector of complying with MISA monitoring requirements are summarized in Table 2.8.

Inorganic Chemical Sector
Summary of Incremental Capital Costs by Monitoring Function
($000's)

Company/Plant	Plant Location	Sampling	Charact-erization	Routine	Toxicity Testing	Flow Measure-ment	Reporting	TOTAL CAPITAL COSTS	% Of Total
Albright & Wilson Americas Inc.	Port Maitland	12.0	0.0	0.0	0.0	0.0	0.0	12.0	1%
Allied Chemicals Canada Inc.	Amherstburg	46.1	0.0	0.0	0.0	26.5	0.0	72.6	5%
Cabot Canada Ltd.	Sarnia	12.5	0.0	0.0	0.0	60.0	0.0	72.5	5%
CIL Inc.- Cornwall *	Cornwall	12.5	0.0	0.0	0.0	10.0	0.0	22.5	2%
CIL Inc.- Courtright	Courtright	329.0	0.0	120.0	0.0	120.0	10.0	579.0	39%
Columbian Chemicals Canada Ltd. *	Hamilton	0.0	0.0	0.0	0.0	10.0	0.0	10.0	1%
Cyanamid Canada Inc.- Niagara Plant	Niagara Falls	62.5	0.0	0.0	0.0	30.0	0.0	92.5	6%
Cyanamid Canada Inc.- Welland Plant	Niagara Falls	32.0	0.0	0.0	0.0	31.0	0.0	63.0	4%
ETI (Canada) Ltd.	North Bay	32.5	0.0	0.0	0.0	10.0	0.0	42.5	3%
Electro Minerals Corporation	Niagara Falls	15.0	0.0	0.0	0.0	0.0	0.0	15.0	1%
The Exolon-ESK Company of Canada Ltd.	Thorold	10.0	0.0	0.0	0.0	10.0	5.0	25.0	2%
Fiberglas Canada Inc.	Sarnia	40.0	0.0	0.0	0.0	60.0	5.0	105.0	7%
General Chemical Canada Ltd.	Amherstburg	13.0	0.0	0.0	0.0	10.0	0.0	23.0	2%
IMC Company (Canada) Ltd.	Port Maitland	2.5	0.0	0.0	0.0	0.0	1.0	3.5	0%
Nitrochem Inc.	Maitland	100.0	0.0	0.0	0.0	5.0	5.0	110.0	7%
Norton Canada Inc. *	Niagara Falls	12.5	0.0	0.0	0.0	20.0	0.0	32.5	2%
Partek Insulations Ltd. *	Sarnia	12.5	0.0	0.0	0.0	10.0	0.0	22.5	2%
Stanchem *	Cornwall	0.0	0.0	0.0	0.0	10.0	0.0	10.0	1%
Sulco Chemicals Limited	Elmira	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0%
Union Carbide Canada Limited	Welland	82.5	0.0	0.0	0.0	75.0	4.0	161.5	11%
Washington Mills Limited	Niagara Falls	7.5	0.0	0.0	0.0	0.0	0.0	7.5	1%
Welland Chemical Ltd.	Sarnia	2.5	0.0	0.0	0.0	1.0	0.1	3.6	0%
TOTAL		837.1	0.0	120.0	0.0	498.5	30.1	1,485.7	100%

Notes:

* Estimates not provided by these plants.

For those plants who did not provide cost estimates, assumptions were made:

-Sampling costs of $12,500 to include 1 refrigerator @$2,500 and 1 sampler @$10.000

-Flow measurement costs: plants with 0-5 streams @$10,000; plants With >5 streams @$20,000

Source: Inorganic Sector Representatives; Text

Table 2.8

Inorganic Chemical Sector
Total Incremental Monitoring Costs
($000's)

Company	Plant Location	Total Operating Costs	Total Capital Costs	TOTAL	% of Total
Albright & Wilson Americas Inc.	Port Maitland	90.7	12.0	102.7	2%
Allied Chemicals Canada Inc.	Amherstburg	357.1	72.6	429.7	8%
Cabot Canada Ltd.	Sarnia	124.3	72.5	196.8	4%
CIL Inc.	Cornwall	268.2	22.5	290.7	5%
CIL Inc.	Courtright	795.8	579.0	1,374.8	25%
Columbian Chemicals Canada Ltd.	Hamilton	42.3	10.0	52.3	1%
Cyanamid Canada Inc.- Niagara Plant	Niagara Falls	138.5	92.5	231.0	4%
Cyanamid Canada Inc.- Welland Plant	Niagara Falls	265.6	63.0	328.6	6%
ETI (Canada) Ltd.	North Bay	57.8	42.5	100.3	2%
Electro Minerals Corporation	Niagara Falls	153.1	15.0	168.1	3%
The Exolon-ESK Company of Canada Ltd.	Thorold	102.1	25.0	127.1	2%
Fiberglas Canada Inc.	Sarnia	78.9	105.0	183.9	3%
General Chemical Canada Ltd.	Amherstburg	288.5	23.0	311.5	6%
IMC Company (Canada) Ltd.	Port Maitland	81.7	3.5	85.2	2%
Nitrochem Inc.	Maitland	226.0	110.0	336.0	6%
Norton Canada Inc.	Niagara Falls	233.8	32.5	266.3	5%
Partek Insulations Ltd.	Sarnia	157.6	22.5	180.1	3%
Stanchem	Cornwall	212.3	10.0	222.3	4%
Sulco Chemicals Limited	Elmira	173.7	0.0	173.7	3%
Union Carbide Canada Limited	Welland	141.5	161.5	303.0	5%
Washington Mills Limited	Niagara Falls	75.2	7.5	82.7	1%
Welland Chemical Ltd.	Sarnia	41.4	3.6	45.0	1%
TOTAL		4,106.1	1,485.7	5,591.8	100%

Source: Tables 2.6 and 2.7

2.11 Costs of Alternative Monitoring Requirements

In order to place these cost estimates in an analytical context, estimates of routine analyses costs under an alternative set of assumptions have been developed.

The Inorganic Chemical Sector Regulation defines plant and effluent-specific requirements and schedules which vary from plant to plant. A seemingly more equitable approach would be to require each plant to implement common sampling and analytical schedules. Using this scenario, an alternative set of routine analyses costs were estimated based on the following assumptions:

1. Inorganic chemical plants subject to the MISA regulations would have to routinely monitor all of their effluent streams for a maximum number of contaminants.

2. "Maximum requirements" are defined as the most stringent monitoring requirements applied under the currently proposed regulations for a single plant.

As shown in Table 2.9, this "stringent" scenario resulted in routine analyses costs ranging from $0.3 million to $2.9 million per plant, and $21.4 million for the entire sector, as compared to the total estimated routine analyses costs, shown in Table 2.4, of $2.4 million.

The costs of other monitoring functions were not calculated for this scenario. It is likely that this particular scenario would imply increased costs for sampling, transportation and reporting, but lower costs for characterization analyses at some plants.

This alternative monitoring scenario would yield more frequent, and hence more reliable, data about effluent quality but would not be necessary to satisfy the regulation requirements or process sufficient data to characterize effluent quality.

For routine analyses alone, therefore, the more stringent scenario could impose $21.7 million in costs on regulated plants. This is $19.4 million more than the point estimate of the routine analyses costs as required by the actual Regulation.

Table 2.9

Inorganic Chemical Sector
Alternative Routine Monitoring Cost Estimate
($000s)

Company	Plant Location	Inorganic Sector Regulation	Stringent Scenario	Difference (*) $	Difference (*) %
Albright & Wilson Americas Inc.	Port Maitland	42.7	784.6	741.9	95%
Allied Chemicals Canada Inc.	Amherstburg	275.3	1,569.1	1,293.8	82%
Cabot Canada Ltd.	Sarnia	58.4	523.0	464.6	89%
CIL Inc.	Cornwall	142.9	523.0	380.1	73%
CIL Inc.	Courtright	589.4	2,876.7	2,287.3	80%
Columbian Chemicals Canada Ltd.	Hamilton	17.5	523.0	505.5	97%
Cyanamid Canada Inc.- Niagara Plant	Niagara Falls	67.9	523.0	455.1	87%
Cyanamid Canada Inc.- Welland Plant	Niagara Falls	225.6	2,876.7	2,651.1	92%
ETI (Canada) Ltd.	North Bay	15.4	1,046.1	1,030.7	99%
Electro Minerals Corporation	Niagara Falls	62.2	1,830.7	1,768.5	97%
The Exolon-ESK Company of Canada Inc.	Thorold	22.1	261.5	239.4	92%
Fiberglas Canada Inc.	Sarnia	53.3	523.0	469.7	90%
General Chemical Canada Ltd.	Amherstburg	97.9	784.6	686.7	88%
IMC Company (Canada) Ltd.	Port Maitland	59.3	261.5	202.2	77%
Nitrochem Inc.	Maitland	114.1	261.5	147.4	56%
Norton Canada Inc.	Niagara Falls	137.5	1,307.6	1,170.1	89%
Partek Insulations Ltd.	Sarnia	59.0	1,046.1	987.1	94%
Stanchem	Cornwall	102.6	261.5	158.9	61%
Sulco Chemicals Limited	Elmira	99.5	523.0	423.5	81%
Union Carbide Canada Limited	Welland	72.8	1,569.1	1,496.3	95%
Washington Mills Limited	Niagara Falls	32.7	523.0	490.3	94%
Welland Chemical Ltd.	Sarnia	5.4	1,307.6	1,302.2	100%
TOTAL		2,353.5	21,706.3	19,352.8	89%

* The difference represents the cost-effectiveness of implementing pipe-specific monitoring requirements.

Source: Table 2.4; Inorganic Chemical Sector Monitoring Regulations

This difference of $19.4 million can be viewed as a measure of the cost-effectiveness of the pipe-specific approach in the proposed regulation for the inorganic chemical sector.

MOE has been cognizant of the potential financial implications of the MISA requirements, and has incorporated such considerations in the development of policy initiatives without a significant loss of technical data.

3.0 ECONOMIC EFFECTS AND IMPLICATIONS OF MONITORING COSTS

3.1 Analytical Procedures

Method

Monitoring costs incurred by the firms under the MISA regulations will increase operating expenses and, unless there is some offsetting increase in productivity associated with wastestream monitoring, profits to the firms and returns on particular plants will be reduced. In this section, economic effects of the monitoring costs on the industry, and on those firms for which financial data are available, will be examined.

The approach taken in this analysis will be to estimate how the appropriate incremental monitoring costs would affect historic after-tax profits, capital expenditures, the return on total assets, and the return on capital employed by each firm. The analysis will show how the monitoring costs would have changed each firm's performance measures if they had been incurred during the worst year, the best year, and an average year over the period of 1981-1987 for which relevant data are available.

These analyses reveal the extent to which monitoring costs would reduce a company's performance measures below its own historical averages.

Plant-specific financial data are seldom available although it is at this level that financial consequences affect the viability of an operation and influence decisions. Assessments and comparisons will generally have to be made using consolidated company data which are publicly available. However, the majority of firms in this sector are privately owned and therefore do not publish annual financial reports.

Only eight of the 19 firms within the inorganic chemical sector published annual reports. As a result, financial analyses are limited to these companies. For some firms, a limited amount of disaggregated data on the chemicals segments of their businesses are published. These data will be used to supplement the analyses where possible.

Finally, where a company believes that it will suffer undue financial burdens by complying with environmental requirements, it may request a detailed financial analysis under provisions of the Ministry's Policy and Procedures Manual (Policy 02-01). Plant-specific analyses would remain confidential under the provisions of The Ontario Freedom of Information Act.

Performance Measures

Where long term investment decisions are concerned, a key economic variable is the rate of return on investment or capital employed. This is the reward that provides the incentive for owners and investors to remain in a particular enterprise or, where it is lacking, to move on to something else. In this study, the Statistics Canada definition of return on capital employed was used in which the ratio is equal to:

$$\frac{\text{net income - extraordinary items + interest}}{\text{total assets - current liabilities}}$$

The rate of return on total assets corresponds to the operating profit margin. It measures the effectiveness with which the firm's assets are deployed in order to earn a profit. The ratio is defined by Statistics Canada to be:

$$\frac{\text{net income + interest}}{\text{total assets}}$$

Consequently, the first analysis will show how the potentially recurring operating costs of monitoring would have affected the rates of return on capital employed and total assets for individual firms for which financial data are available.

For these analyses, operating costs of monitoring were first reduced by the amount of the appropriate corporate tax rate because part of these costs are offset by reduced income taxes. The adjusted incremental operating cost of monitoring was then subtracted from after-tax profits to determine a new rate of return. This calculation was carried out for each firm in each year for which data were available. The new rates of return could then be compared with each firm's historical performance records.

Another analytical approach involves calculating the ratio of operating costs of monitoring to after-tax profits (net income). This ratio indicates the proportion of after-tax profits, assuming that the firm was unable to pass on any of the monitoring costs as increased prices, that would have to be diverted to monitoring activities. This calculation yields an over-estimate of the effect because operating costs of monitoring are not reduced by the corporate tax rates as was done in the previous analyses.

A fourth analytical procedure was carried out to determine the extent to which capital requirements for monitoring would divert capital expenditures away from other uses. Estimated capital costs of monitoring were thus computed as a percent of total capital expenditures for each firm in each year which capital expenditure data are available.

There is no rule of thumb as to what proportion of capital expenditures should be devoted to environmental protection in any given year. Some industrial representatives assert that a minimum capital expenditure is necessary to carry out a sufficient amount of repair and replacement in order to keep a plant running. These basic expenditures apparently vary from industry to industry and from firm to firm.

This comparison of expected capital expenditures to actual outlays is conservative in that it over-estimates the potential diversion of funds in a given year. Environmental capital expenditures can be fully deducted against income over a three year period at the rate of 25%, 50%, and 25%. Therefore, the reduction to income in a single year would be less than the full amount of capital expenditure that is used in this analysis.

International competitiveness can be affected by environmental expenditures to the extent that firms may be unable to maintain product quality or pass along cost increases in the face of international market-determined competitive prices for specific products.

These analyses are by no means definitive, but they can identify those firms which could experience financial effects that are large relative to:

(a) their own historical performance,
(b) other firms' performance in the same industry, and/or
(c) industry performance.

Furthermore, while it would be ideal to assess the consequences of increased costs on individual plants, assessments at the level of the firm are better than no information at all.

3.2 State of the Industry and Outlook

The inorganic chemical sector in Canada and Ontario is discussed in the industry profile entitled "The Economic and Financial Profile of the Ontario Inorganic Chemicals Industry" by Woods Gordon Management Consultants (August 1987) and in various publications from the Canadian Chemical Producers' Association (CCPA).

Inorganic chemicals are distinguished from organic chemicals in that they do not generally contain carbon as a principle element and are derived from non-living materials in the earth's crust, such as minerals, metals, and salt. The industry is primarily engaged in the production of bulk or commodity chemicals such as chlor-alkalies, acids, inorganic compounds and rare earth metal salts. Major products include sulphuric acid, soda ash, phosphorus, chlorine and caustic soda. Inorganic chemical products are important in the production processes for pulp and paper, textile processing, fertilizers, paints and detergents.

The inorganic chemical industry is a fairly small, but growing part of the Canadian chemicals industry. It accounted for 12% or $2.2 billion in Chemical and Chemical Products Industry shipments in 1985, about 12.6% in 1986 and 12.7% in 1987 (DRIE 1987). Additional shipments of inorganic chemicals are accounted for by establishments that are primarily engaged in the production of organic chemicals and products.

Data on individual inorganic chemical producers in Ontario and Canada are usually consolidated with financial statistics of the parent multinational or multi-product firms that represent a major share of the industry. As noted, most of the firms within this sector do not publish financial statistics.

Firms in the industry tend to be capital intensive. The inorganic chemical sector firms subject to the MISA monitoring requirements collectively expended over $170 million on capital expenditures between 1981 and 1987.

Many of the firms in this sector are vertically integrated and foreign-controlled.

The Ontario inorganic chemical industry is a net exporter, accounting for about 60% of industry shipments, primarily to the United States. The U.S. market is very competitive, with many U.S. based and foreign firms selling the same products or close substitutes. The Canadian market is also competitive, with the price for commodities heavily influenced by international markets.

This dependence on the export market and the industry view that it has a low ability to affect the international pricing makes it difficult for Ontario producers to pass on cost increases in the form of higher prices unless all the other firms are subject to the same costs.

While it is difficult to compare inter-jurisdictional environmental standards and their requirements, it is fair to say that most industrialized nations are imposing similar, if not more stringent, pollution control requirements with respect to air, water, and waste.

As with other industries, chemical plants are facing increasingly stringent environmental controls in virtually all other jurisdictions. Chemical firms in the United States must operate under "Best Available Technology, Economically Achievable" (BATEA) Effluent Limitation Guidelines (MOE MISA, 1989a).

The inorganic chemical industry is recovering from the recession of the early 1980's. There has been much cost cutting since 1982, preventing a decline in value-added despite subsequent low demand, weak prices and excess capacity. Reductions in certain input factor prices such as natural gas, and recent stability in electricity costs also assisted the industry in its recovery. Its recovery, however, is not as strong as other players in the chemical and chemical products industry.

Modest growth is expected for the inorganic chemical industry through 1991.

Among the industries that purchase inorganic chemicals, the automotive sector is expected to show slow growth in North America, although a greater use of plastic and ceramic parts could offset some of the negative implications for inorganic chemical sales; pulp and paper is

expected to perform well over the next decade; and agricultural demand for chemicals could be affected by a forecast of continued financial difficulties facing farmers.

The implications of the Canada-U.S. Free Trade Agreement (FTA) on the inorganic chemical industry is uncertain although many in the industry expect to gain sales from reduced barriers to their largest export market. Exports of inorganic chemicals to the United States represented about 30% ($1.1 billion) of 1987 chemical and chemical product exports from Canada.

3.3 Sectoral Economic Impact

Performance Measures

Published financial data for the eight firms are shown in Table 3.1. These eight firms own 12 of the 22 plants in the sector. Where one firm owns more than one plant, the incremental costs of monitoring at each plant have been aggregated and then assessed in relation to financial indicators of the parent company for which financial data are available.

Table 3.2 details the impact, on these eight firms, of the MISA cost of monitoring on the four performance measures discussed in Section 3.1: capital expenditures, net after-tax income (loss), and the rates of return on capital employed and total assets.

The incremental operating costs of monitoring would have reduced average ratios of individual firms or the aggregate of the eight companies by 1% or less. This reduction is well within the historic variation of these ratios for all of the companies and is judged not to be significant.

The average annual capital expenditure for the eight firms in Table 3.1 from 1981-1987 was about $175 million. The capital costs of monitoring for each of these eight firms represent 0.28% (Union Carbide) to 5.4% (Nitrochem) of average annual capital expenditures. If the monitoring regulations were in effect during the years in which the highest level of capital expenditures were made, the capital costs of monitoring would have represented 0.14% to 2.29% of their capital expenditures. Again, these effects are not judged to be detrimental to the firms' financial position.

Table 3.1

Inorganic Chemical Sector
Selected Financial Statistics For Individual Firms
($000's)

Company	Statistic	1981	1982	1983	1984	1985	1986	1987	Average
Allied Chemicals Canada Inc.	Net Income	98,387	14,001	5,395	21,827	19,545	--	--	31,831
	Capital Expends	20,817	17,524	10,363	13,559	13,101	--	--	15,073
	Ret on Cap Emp	15.7%	9.1%	6.4%	12.1%	13.7%	--	--	11.8%
	Ret on Assets	30.6%	5.8%	3.6%	9.4%	7.1%	--	--	12.1%
E-I-L Inc.	Net Income	49,166	13,686	26,417	35,000	18,000	(12,000)	40,000	24,324
	Capital Expends	130,600	87,000	109,000	118,000	118,000	53,000	40,000	93,657
	Ret on Cap Emp	9.4%	6.7%	5.3%	6.4%	7.3%	6.0%	7.8%	6.9%
	Ret on Assets	7.0%	5.0%	4.4%	4.9%	3.9%	1.8%	5.9%	4.6%
Cyanamid Canada Inc.	Net Income	10,097	1,843	2,403	12,257	6,689	(4,566)	--	4,787
	Capital Expends	27,635	31,476	19,231	13,944	10,628	14,583	--	19,583
	Ret on Cap Emp	7.2%	1.3%	1.7%	7.8%	4.2%	-2.8%	--	3.2%
	Ret on Assets	5.9%	0.9%	1.1%	5.3%	3.3%	-2.0%	--	2.3%
The Exolon-ESK Company of Canada Ltd.	Net Income	(40)	(511)	(116)	347	(1,098)	(204)	--	(270)
	Capital Expends	240	274	249	910	5,361	1,453	--	1,415
	Ret on Cap Emp	-7.0%	-10.6%	-2.5%	6.8%	-14.5%	-3.1%	--	-4.7%
	Ret on Assets	-5.0%	-6.9%	-1.5%	3.7%	-7.1%	-1.3%	--	-2.5%
Fiberglas Canada Inc.	Net Income	15,914	9,142	17,232	14,773	20,670	--	--	15,546
	Capital Expends	9,259	6,303	9,749	15,910	16,011	--	--	11,446
	Ret on Cap Emp	21.4%	10.5%	13.8%	12.9%	17.1%	--	--	17.3%
	Ret on Assets	13.6%	8.6%	11.3%	9.6%	12.3%	--	--	11.0%
Nitrochem Inc.	Net Income	1,081	(856)	(5,893)	(2,914)	(1,767)	(1,667)	--	(2,003)
	Capital Expends	2,019	1,827	1,308	1,031	1,240	4,804	--	2,038
	Ret on Cap Emp	6.6%	16.5%	-4.5%	10.0%	14.5%	11.9%	--	11.5%
	Ret on Assets	9.2%	9.4%	-1.8%	5.4%	8.7%	7.2%	--	6.2%
Norton Canada Inc.	Net Income	2,820	1,914	1,586	2,951	--	--	--	2,318
	Capital Expends	375	409	718	1,201	--	--	--	676
	Ret on Cap Emp	19.6%	16.0%	8.7%	18.7%	--	--	--	15.4%
	Ret on Assets	14.0%	11.9%	7.1%	13.7%	--	--	--	11.6%
Union Carbide Canada Limited	Net Income	36,139	(17,907)	(1,439)	(28,193)	(89,641)	47,497	31,490	(3,151)
	Capital Expends	100,017	118,571	55,921	26,634	29,139	41,304	34,600	58,027
	Ret on Cap Emp	7.7%	0.8%	3.2%	4.6%	4.6%	7.2%	8.6%	5.0%
	Ret on Assets	6.0%	0.7%	2.7%	0.1%	-8.6%	10.8%	8.2%	2.7%

Legend:

Net Income = after-tax earning(loss)
Capital Expends = capital expenditures
Ret on Cap Emp = return on capital employed
Ret on Assets = return on total assets

Source: Company Annual Reports

The impact of incremental operating costs due to monitoring represent 0.51% (Fiberglas) to 10.09% (Norton) of average after-tax income of five of the eight firms. Three of the firms posted average after-tax losses so that the imposition of additional costs would have increased their losses by 4.49% (Union Carbide) to 37.77% (Exolon-ESK). In their most profitable years, the operating costs of monitoring would have represented anywhere from 0.30% to 29.42% of net income for these two firms.

The incremental operating costs of monitoring would impose a 1% change or less in the rates of return on capital employed and total assets for all eight firms for which financial data are publicly available.

Other Indicators

The MISA inorganic chemical sector employs over 3,800 people (MOE MISA, 1989a). This represents about two thirds of Ontario inorganic chemical industry employment levels. The imposition of MISA monitoring requirements and costs on the inorganic chemical sector plants are not expected to reduce employment opportunities in the sector, but will likely enhance employment opportunities for consultants, analytical laboratories, and equipment manufacturers.

The incremental monitoring costs are not expected to adversely affect the international competitiveness of the firms in the inorganic chemical sector since monitoring accounts for a small fraction of the aggregate industry costs and profits, and because the bulk of the monitoring costs will be incurred during one year.

These criteria, however, should be carefully considered in terms of their usefulness in assessing the impacts of MISA on Ontario plants. An important question is whether the products from the sector plants remain competitive rather than the firm as a whole. If MISA causes a product to become non-competitive, the firm would shut down the production facilities of the product, but the firm itself could remain as profitable as before in their other plants or fields of endeavour. The problem, as noted earlier, is a lack of plant-specific data with which to make such assessments. In the absence of such information, corporate data were used where available.

Ministry staff wrote to each plant in this sector explaining the purpose of intent of the present report and requested the provision of plant-specific financial information. Of the 17 out of 22 plants that responded, only 3 provided any of the requested financial information. Even these 3 plants limited the information to basically number of employees and broad ranges of annual sales and environmental expenditures. All the plants felt that plant- specific data was proprietary in nature.

Measures for the inorganic chemical sector such as demand, sales and earnings performed better in 1987 over 1986. While 1988 levels did not rise as dramatically, the sector on the whole is in better shape than financial statistics for 1981-1986 indicate. Consequently, monitoring costs would have a smaller impact over the next 12-24 months than if they had been incurred in previous years.

3.4 Financial Analyses of Selected Inorganic Chemical Sector Firms

Allied Chemicals Canada Inc./General Chemical Canada Ltd.

Allied Chemicals Canada is a wholly owned subsidiary of Allied Signal Canada. At the end of 1985, operations at Allied's Amherstburg complex were split between Allied and General Chemical Canada. As a result, financial statistics for General Chemical are not available. The monitoring costs of MISA to be incurred by both firms are therefore assessed against the financial statistics of Allied prior to the reorganization.

In 1984, chemical products accounted for about 66% of Allied's net income. Sales rose by 8.4% in 1985, after steadily declining between 1981-1984.

The Allied and General Chemical plants in Amherstburg which are subject to MISA currently employ about 600 people.

The capital costs of monitoring represent 0.63% of average capital expenditures. The average rate of return on capital employed would be reduced by only 0.2% over the period 1981-1987 due to the imposition of monitoring operating costs. The operating costs of monitoring would have also reduced average after-tax income by 2.03%, and changed the average rate of return on total assets by 0.14%.

C-I-L Inc.

C-I-L incurs MISA related costs through three plants in the inorganic chemical sector; the two C-I-L plants at Cornwall and Courtright, and Stanchem, which is a Division of C-I-L, also located in Cornwall.

C-I-L is also subject to MISA monitoring costs associated with the organic chemical manufacturing sector. Monitoring costs for C-I-L plants in this other sector have been estimated to be $135,600.

The company's earnings have dropped slightly in recent years due to slowdowns in agriculture, mining and petroleum. However it rebounded from a loss of $12 million in 1986 to a net profit of $40 million in 1987. Over the 1981-1987 period, C-I-L's average profit was $24.3 million. C-I-L is optimistic, and considers itself to be in a good position for a market upturn (C-I-L Annual Report, 1987).

Increased selling prices of inorganic chemicals and other efficiencies pushed operating profit in 1987 solidly over 1986 in C-I-L's Forest Products and Polymers Group (C-I-L Annual Report, 1987).

Stanchem is hailed by C-I-L as Canada's largest chemical distributer, packaging and selling a wide range of products to markets in all sectors of the Canadian economy. In March 1987, Stanchem bought a dimethyl ether plant in Ajax, Ontario making the company the only Canadian producer of "DMO", an "environmentally safe propellant" (C-I-L Annual Report, 1987).

Stanchem sales and operating profit in 1987 were also above 1986 levels (C-I-L Annual Report, 1987).

The total MISA monitoring costs for the three C-I-L-owned plants represent 0.65% of C-I-L's average capital expenditures and 5.25% of average annual after-tax income for the 1981-1987 period.

Ratio analyses indicate a negligible impact of the rates of return of capital employed and total assets.

Cyanamid Canada Inc.

Cyanamid has two plants in this sector, both in Niagara Falls. Together, these plants employ about 600 people.

This firm produces agricultural, chemical and medical products of which the chemical segment comprises about one third of total sales. As indicated in Table 3.1, a net loss in 1986 was primarily a result of reduced demand for agricultural chemicals. The chemical products division experienced an increase in the operating profits of almost 50% in 1986 even though sales did not change (Woods Gordon, 1987).

The incremental capital costs of monitoring would be 0.79% of average annual capital expenditures over 1981-1987, and just over 1% of the lowest of such expenditures during this period. Average after-tax income would have been reduced by 8.44% by the operating costs of monitoring.

The ratio analyses indicate that return on investment and capital employed would be reduced by no more than 0.16%.

The Exolon-ESK Company of Canada Ltd.

The Canadian plant operated by this company has posted losses in all years except 1984, even though sales rose by 12.8% in 1986 (Woods Gordon, 1987). It employs about 150 people. According to the 1986 Annual Report of its parent company, Exolon-ESK Company (U.S.), higher volumes in 1986 were offset by price declines in the company's major product lines.

Because of these net losses, which averaged $270,000 over the period 1981-1986, the incremental operating costs of monitoring would have increased this average loss by 37.77%. Capital expenditures rose significantly in 1985 and 1986 over previous years. The capital costs of monitoring represent 1.77% of average annual capital expenditures for the period.

The average rate of return on capital employed would have been reduced by 1.03% by the capital monitoring costs, and the average rate of return on total assets would have declined by 0.55% due to the imposition of incremental operating costs of monitoring.

While these figures indicate that the company may incur a financial burden in meeting monitoring costs, the company has not indicated that the imposition of such costs will be problematic. In the absence of financial data since 1986, it is not possible to determine a more accurate assessment of the economic consequences of MISA monitoring requirements to Exolon-ESK.

Fiberglas Canada Inc.

The company has been consistently profitable, even during the recession in 1982, and is well capitalized (Deloitte Haskins & Sells, 1987). It has had an average annual growth in sales of about 9% since 1982, and posted very good returns on capital employed and assets (Deloitte Haskins & Sells, 1987).

Fiberglas Canada has an average debt to equity ratio of about 1:3.5, sufficient to increase return on equity by earning profits on borrowed funds at a higher rate than that paid to the lender while maintaining an acceptable level of financial risk (Deloitte Haskins & Sells, 1987).

Total capital expenditures between 1981 and 1985 were about $57 million, equal to 40% of cash generated from operations.

The Sarnia plant subject to MISA employs 455 people.

Monitoring costs represent only 0.92% of average annual capital expenditures and 0.51% of average after-tax income. Ratio analyses indicate virtually no impact on the consolidated financial statement.

Nitrochem Inc.

In 1985, the chemicals and fertilizers segment which operates in Canada, experienced a 45% increase in operating profits before interest and accounted for 84% of net sales. The explosives business, centred in the United States, has performed poorly by comparison, and has been a primary contributor to Nitrochem's poor overall results (Woods Gordon, 1987).

The company has posted a net loss since 1982. The incremental operating costs of MISA therefore would have increased average net losses by 11.28%.

Conversely, capital expenditures in 1986 rose by $3.6 million over 1986. The capital costs of monitoring thus represent 5.4% of average capital expenditures, and only 2.29% of the 1986 level of investment.

The average rate of return on capital employed would have declined by only 0.54%, and the average rate of return on total assets by 0.29%.

The Nitrochem plant in Maitland subject to MISA employs 175 people.

Norton Canada Inc.

Norton Company, the U.S. parent, operates in Canada through Norton Canada Inc., but also produces at Canadian plants owned either directly or through another subsidiary. In spite of a declining abrasives industry, Norton was profitable for the years 1981-1985 (Deloitte Haskins & Sells, 1987).

The company was reorganized in 1985, and financial statistics are not available for subsequent years. The plant in Niagara Falls subject to MISA employs 225 people.

Annual capital expenditures amounted to about 22% of cash generated from operations. Although the MISA monitoring costs are therefore not very useful when compared against Norton Canada's financial statistics, they are the only indicators available. Average capital expenditures would have been reduced by 4.81% and average after-tax profit by 10.09%.

Ratio analyses indicate less than a 1% impact.

Union Carbide Canada Limited

Union Carbide produces plastics, chemicals, industrial, medical and specialty gases and carbon products to serve primarily industrial customers. In 1985, Union Carbide sold its polyethylene business to Novacor Chemicals, and in 1986, divested itself of its consumer products operations.

Sales were up by 17% in 1987 after remaining unchanged between 1985-1986. This increase took place entirely in the plastics and chemicals division which posted sales of $140 million in 1986 and $200 million in 1987. Operating profits doubled to $18.5 million in 1987. Sales and

profits attributed to gases and carbon (inorganic chemicals) experienced no growth in 1987 although this division accounts for 60% of operating profits (Woods Gordon, 1987).

The Welland plant subject to the MISA regulations employs 600 people.

The strong posting of net income in 1986 and 1987 resulted in an average net loss of just over $3 million over the period 1981-1987. The incremental operating costs of monitoring would have further increased this loss by 4.49%. In the high profit year of 1986, net income would have been reduced by only 0.30%.

Capital expenditures for Union Carbide seem to be on a roller coaster. However, the capital costs of monitoring constitute only 0.28% of average capital expenditures.

The rates of return on capital employed and total assets would have both been reduced by only 0.01%.

Remaining Firms

As noted, financial data for the remaining 11 firms (11 plants) in the inorganic chemical sector are not publicly available. While the two sector profiles (Woods Gordon, 1987; Deloitte Haskins & Sells, 1987) provided general overviews of some of these companies, insufficient information exists with which to assess the potential impact of MISA monitoring costs.

Table 3.2

Inorganic Chemical Sector
Impact of Plant-Specific Monitoring Costs On Selected Financial Indicators of Firms

Company	CAPITAL EXPENDITURES: Monitoring Capital Cost as a % of Annual Capital Expenditures			AFTER-TAX INCOME(LOSS): Monitoring Operating Cost as a % of Annual After-Tax Income(Loss)			RATE OF RETURN ON CAPITAL EMPLOYED: Change in Ratio due to Monitoring Operating Cost			RATE OF RETURN ON TOTAL ASSETS: Change in Ratio due to Monitoring Operating Cost		
	Average Year	Highest Year	Lowest Year	Average Year	Highest Year	Lowest Year	Average Year	Highest Year	Lowest Year	Average Year	Highest Year	Lowest Year
Albright & Wilson Americas Inc. *												
Allied Chemicals Canada Inc.	0.63%	0.46%	0.92%	2.03%	0.66%	11.97%	-0.20%	-0.13%	-0.18%	-0.14%	-0.13%	-0.14%
Cabot Canada Ltd. *												
CIL Inc.- Cornwall)	0.65%	0.47%	1.53%	5.25%	2.60%	-10.64%	-0.09%	-0.10%	-0.09%	-0.07%	-0.11%	-0.05%
CIL Inc.- Courtright)												
Columbian Chemicals Canada Ltd. *												
Cyanamid Canada Inc.- Niagara Plant)	0.79%	0.49%	1.07%	8.44%	3.30%	-8.85%	-0.16%	-0.15%	-0.18%	-0.11%	-0.13%	-0.11%
Cyanamid Canada Inc.- Welland Plant)												
ETI (Canada) Ltd. *												
Electro Minerals Corporation *												
The Exolon-ESK Company of Canada Ltd.	1.77%	0.47%	10.42%	-37.77%	29.42%	-9.30%	-1.03%	-1.17%	-0.81%	-0.55%	-0.63%	-0.41%
Fiberglas Canada Inc.	0.92%	0.66%	1.67%	0.51%	0.38%	0.86%	-0.04%	-0.01%	-0.01%	-0.02%	-0.03%	-0.03%
General Chemical Canada Ltd. **												
IMC Company Canada Ltd. *												
Nitrochem Inc.	5.40%	2.29%	10.67%	-11.28%	20.91%	-3.84%	-0.54%	-0.56%	-0.72%	-0.29%	-0.33%	-0.26%
Norton Canada Inc.	4.81%	2.71%	8.67%	10.09%	7.92%	14.74%	-0.88%	-0.89%	-0.76%	-0.66%	-0.71%	-0.58%
Partek Insulations Ltd. *												
Stanchem ***												
Sulco Chemicals Limited *												
Union Carbide Canada Limited	0.28%	0.14%	0.61%	-4.49%	0.30%	-0.16%	-0.01%	-0.01%	-0.01%	-0.01%	-0.05%	-0.01%
Washington Mills Limited *												
Welland Chemical Ltd. *												

Notes:
* Financial data not available
** Part of Allied Chemicals Canada until end of 1985
*** Stanchem is a Division of CIL

Source: Table 2.8 and Table 3.1

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

Incremental capital and operating costs of monitoring for the MISA-defined inorganic chemical sector in Ontario range from $45,000 (Welland Chemical, Sarnia) up to $1.4 million (C-I-L, Courtright). The total incremental cost of monitoring for the sector is estimated to be $5.6 million. Point estimates for individual firms are expected to vary by +/- 20%.

Based on comparisons of the estimated monitoring costs of the proposed Regulation with potential costs under a more "stringent scenario", the proposed plant and effluent-specific regulations are far more cost-effective. Routine analyses of the current proposed site-specific regulations are $19.4 million less than the more stringent scenario.

The economic impacts of the estimated monitoring costs on the inorganic chemical sector are small in relation to aggregate industry financial indicators.

For the individual firms subject to the MISA monitoring requirements, the impacts are varied. An added difficulty in assessing probable impacts is the lack of not only plant-specific data, but an absence of publicly available financial information at a corporate level.

Impacts on annual average after-tax profits (losses) range from reductions in net income ranging from 0.51% (Fiberglas, Sarnia) to 10.09% (Norton, Niagara Falls), and increases in net losses ranging from 4.49% (Union Carbide, Welland) to 37.77% (Exolon-ESK, Thorold).

The inorganic industry is recovering from the 1982 recession, but not as strongly as other players in the chemical and chemical products industry. Growth in this industry is expected to remain moderate in the medium term.

Despite a modest financial forecast, the industry may be able reap benefits from the monitoring requirements. Firms may gain goodwill and be seen by the public as being sensitive to clearly stated public concerns about the degradation of the environment by industry.

Internationally, firms can be seen as sound corporate players. Other jurisdictions which are not as environmentally astute as Ontario are expected to become increasingly sensitive. Firms in those jurisdictions will likely have to expend even more funds in order to meet expected requirements. As Ontario is currently implementing more stringent environmental standards, costs incurred by Ontario industry today should be less than costs incurred by firms in other jurisdictions to meet similar standards tomorrow.

The need to meet the MISA and other environmental initiatives may encourage firms to change processes and/or input requirements and become more environmentally responsible citizens. The monitoring requirements may also enhance employment opportunities for consultants, analytical laboratories and equipment manufacturers.

Finally, the imposition of monitoring requirements is another step in controlling the release of contaminants to our environment. Monitoring is a preamble to the abatement of effluent contamination.

4.2 Recommendations

The foregoing analyses indicate that the financial impacts of the monitoring regulations on plants within the inorganic chemical sector can be varied. In order to identify possible problems at an early stage, it is recommended that the MOE also monitor the actual incremental capital and operating costs of the monitoring activities during the tenure of the Regulations. Early identification of possible financial burdens will enable MOE and the individual plant to review and assess workable solutions.

MOE must also examine the impact of the MISA monitoring requirements on those firms who are responsible for plants in more than one industrial sector. Examples of such firms include C-I-L and Domtar.

Also, at the end of the regulation period, each plant should attempt to record and report the actual incremental costs incurred due to the MISA monitoring requirements in order to:

- validate and improve the cost-estimation procedures used in this report.

- monitor and assess the financial and employment impacts of the monitoring requirements, especially on individual plants.

- help to determine the full financial impact of the MISA requirements when the costs of the limits regulations are determined.

Finally, when monitoring data and activities at these plants (and other industrial dischargers) are audited by MOE personnel or their agents, information should be gathered to determine whether the monitoring activities or data have been, or could be, helpful in making the operations or processes more efficient and productive.

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